

Two Reinsurance Paradigms

THE REINSURANCE INDUSTRY has seen a major convergence between traditional players and new entrants seeking to profit from untapped opportunities. This installment of *Market Insights* examines two main paradigms in reinsurance—diversification and risk aversion—and explains why our firm’s reinsurance investment approach typically yields a riskier, more concentrated, but we also think ultimately more attractive, portfolio than the strategies employed by many of our peers.

Before detailing that argument, we start with a quick overview of the reinsurance industry and its structure for those less familiar with it.

Background

Like individuals or firms, insurance companies must protect themselves against losses they cannot sustain themselves (or which the rating agencies responsible for evaluating their creditworthiness essentially do not permit them to take). As such, insurers are willing to pay a risk premium to another party, the reinsurer, to take that excess risk (i.e., pay the reinsurer for payouts in excess of the expected losses projected for the particular risk covered).

The insurance industry is divided into two segments: *life* and *property casualty*. *Property catastrophe* is a major sub-segment of property casualty and covers property losses that may result from catastrophic events, with a focus on natural catastrophes, such as hurricanes, earthquakes, and the like. Many insurance companies focus on a specific geographic region and would not be able to successfully manage solely on their own balance sheet the losses associated with a large natural disaster on their home turf. Reinsurance is thus an integral part of their risk mitigation process.

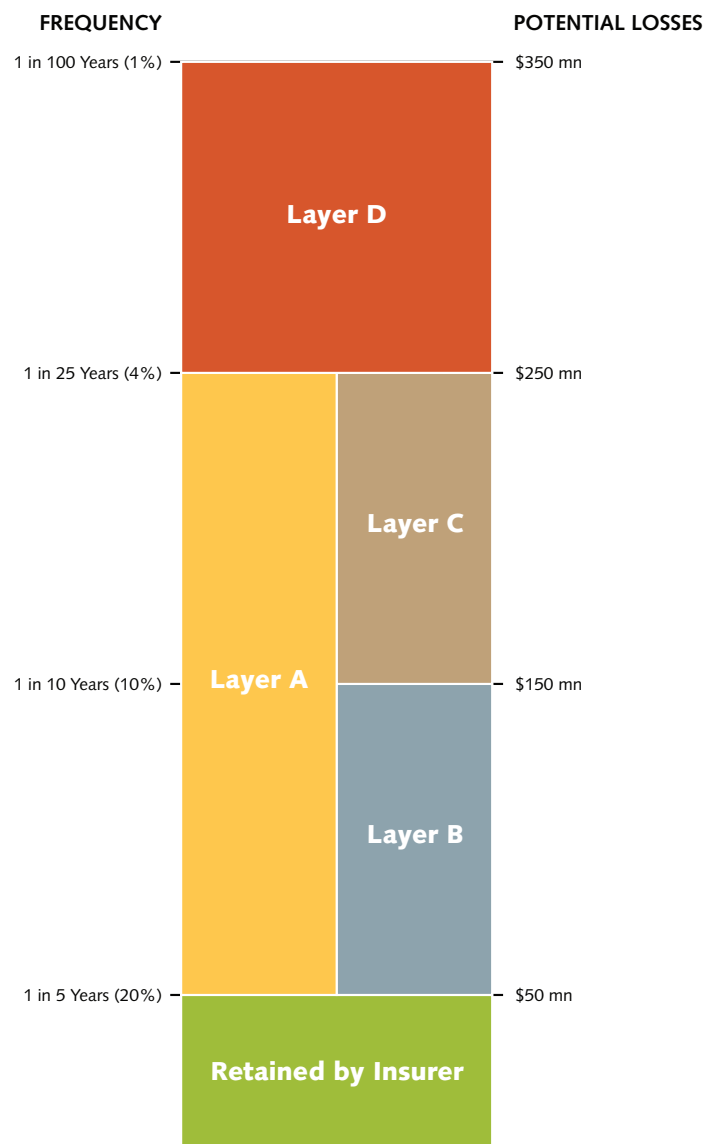
Here's how it works. Consider a Florida-based homeowner insurance company that insures 10,000 homes in Florida. This insurer could typically handle on its own balance sheet any property losses arising from fire, theft, and other localized events. These losses can be predicted with a high degree of accuracy and low degree of deviation from one year to another, given the large number of independently insured properties and reliable statistics on the occurrence of these sorts of events. Thus, the insurer needs to maintain only a relatively modest capital buffer to absorb any deviations from such losses.

In contrast to these localized events, the Florida insurer's balance sheet would be unable to sustain losses arising from a large hurricane that destroys 1,000 homes in its portfolio. Managing that risk would require the insurer to preserve a sizable amount of capital on its balance sheet year after year, even though losses of that magnitude would be infrequent. Such a solution would be very inefficient from a cost of capital standpoint. Reinsurers—with their ability to diversify risk—can unburden insurance companies of some of that risk, allowing them to maintain a capital-efficient operation. Those reinsurers can, in turn, also purchase reinsurance protection, which is called “retrocessional” or “retro.”

Reinsurance contracts may take different forms. One type is a *facultative* contract, in which the reinsurer assumes a portion of a *particular* risk in the insurer's portfolio (e.g., it

may share with the insurer the risk of a specific large estate in the insurer's portfolio being wiped out by fire). A second form of reinsurance is a *quota share*, in which the insurer shares with a reinsurer on a *pro rata* basis the economics of a part or its entire book of business. Third, and most relevant to our business, reinsurance may be structured as an “excess-of-loss” contract, which protects the insurer against specific, pre-defined losses to its book. The following sketch, typically used in the reinsurance industry to represent such contracts, shows four layers of excess-of-loss coverage that might be purchased by, for example, a Florida-based insurance company.¹

[Figure 1]



¹ The data shown in Figure 1 is stylized and not consistent with any real-world case.

The right-hand numbers represent levels of potential losses to the insurer prior to any reinsurance recoverable (losses “from the ground up” in industry jargon). The numbers on the left represent the expected frequency of such losses (this would be called the “return period” in industry parlance). An excess-of-loss contract may cover the insured against *aggregate* losses during the risk period (typically one year) arising from a series of events or, more commonly, against losses arising from a *single event*. Assuming the latter, here’s a breakdown of these layers:

- The bottom part of the tower is retained by the insurer, which would absorb losses of up to \$50 million arising from any single event. This piece is somewhat similar to the equity tranche of a securitized deal or the deductible on a homeowner or automobile insurance policy.
- Protection on Layer A is provided by the Florida Hurricane Catastrophe Fund (FHCF), a vehicle created by the Florida Legislature to provide insurers with subsidized protection and thereby reduce insurance costs for Florida homeowners. In our hypothetical example, which only roughly depicts how the FHCF functions, the FHCF would cover 50% of losses between \$50 and \$250 million. For example, if the insurer suffered losses of \$100 million from one event, then the FHCF would reimburse it for \$25 million of its losses (*i.e.*, 50% of the losses between \$50 and \$100 million).
- Layer B sits side-by-side with the bottom of Layer A and represents an exposure to 50% of losses between \$50 and \$150 million. Per the diagram’s frequency scale, the annual probability that this layer will begin to suffer losses (or “attach”) is about 20%,² and the odds that it will suffer a total loss (or “exhaust”) are 10%. The expected loss³ of this layer would fall between those two numbers (typically, slightly below their average). A layer’s expected loss is one of the salient factors that reinsurers consider when pricing a deal, along with the standard deviation of that expected loss, the layer’s expected impact on the reinsurer’s total portfolio, and various other qualitative and quantitative factors.

- Similarly, Layer C exposes the reinsurer to 50% of the insurer’s losses between \$150 and \$250 million. There’s a 10% annual probability that this layer would attach and a 4% annual probability it will exhaust. Its expected loss is roughly 7%.
- Layer D exposes the reinsurer to all of the losses between \$250 and \$350 million. There’s a 4% annual probability that this layer will attach and a 1% probability it will exhaust, and its expected loss is in the neighborhood of 2.5%.

If the insurer purchased coverage for layers A, B, C, and D and then experienced losses of over \$350 million, it would exhaust its reinsurance coverage altogether and be obligated to pay all losses in excess of that amount. That would typically mean insolvency for the insurer and its failure to pay all insured policyholders, unless a government agency opted to step in.

Hedge Funds in the Reinsurance Space

Hedge fund managers that have entered the reinsurance market can be divided roughly into three groups. Some firms employ a business model that combines hedge fund activities within a reinsurance “wrapper” structure. In this model, a hedge fund manager raises capital for a rated reinsurance entity that writes protection on relatively low-risk events and then invests a large portion of its balance sheet in its hedge fund strategies. Current notable players in this space include Third Point LLC and Greenlight Capital Inc. This structure can provide the hedge fund manager with a form of permanent capital and may offer investors the added upside from the reinsurance strategy, a potentially profitable exit, and certain structural and tax benefits. Investors in this kind of structure are much more exposed to the fund manager’s investment strategies and to capital markets than they are to reinsurance risk *per se*. Although this is an interesting approach (and one our firm doesn’t pursue), this paper doesn’t evaluate its relative merits.

Other hedge funds active in the space offer investors more direct exposure to reinsurance risk and can be further divided into those investing in a rated reinsurance vehicle (whether or not managed internally) and those utilizing an unrated vehicle. Managers of the latter type, ourselves included, generally collateralize their obligations through trust accounts set up for each contract. Although this structure does not furnish the effective leverage available to a rated entity (we’ll discuss the link between ratings and leverage below), it offers other important advantages, including that it

² When analyzing any actual deal, a reinsurer would, among other things, scrutinize the information provided by the insurer and generate its own estimate of the expected loss of each layer, which typically would be higher—sometimes meaningfully higher—than that provided by the insurer.

³ For simplicity, all expected loss figures in this paper are examples and ignore the time value of money and other factors that would have a marginal impact on those estimates in any actual deal.

can be set up quickly and wound down if market conditions are no longer attractive. (A rated entity would take several years before it could wind down and return any excess funds to its investors.)

Hedge fund firms seeking direct exposure to reinsurance risk, whether through rated or unrated entities, tend to focus their activities on property catastrophe risk, typically through excess-of-loss contracts, for several reasons.

First, most observers agree that catastrophe risk is by and large uncorrelated to other asset classes. In most cases, earthquakes or severe aviation accidents don't influence—and certainly aren't caused by—capital markets, although a given catastrophic event could have an impact on those markets if it's large enough.

Second, we believe that property catastrophe is a business in which one can expect, over the long run, to get paid a risk premium that can sometimes be abnormally large because the reinsurance market is inefficient and opaque: it has high barriers to entry, its positions (reinsurance contracts) are illiquid, information does not flow freely, and non-market participants like regulators and rating agencies meaningfully constrain the activities of market players.

Finally, property catastrophe is what the reinsurance industry calls a “short-tail” business. In this context (and not as meant in statistics or portfolio theory), short tail means that the duration of the risk period and the time between a loss event and a payout on that loss are both relatively short (in contrast to liability or life insurance claims, for example). The recognition of claims also happens relatively quickly after a covered event occurs. For example, a reinsurer usually will know shortly after an earthquake whether it has exposure, even if the exact amount has yet to be determined. By contrast, in a long-tail business, the events that give rise to claims (for example, a malpractice liability) are not immediately known to the insurer and may become known only years later when a policyholder submits a claim or following a court ruling or judgment. The short-tail nature of the property catastrophe business is especially attractive to hedge fund managers that operate unrated entities and therefore must collateralize their obligations until the level of losses becomes clear. Minimizing that period and thereby maximizing capital efficiency are essential for such managers. By contrast, rated entities need to set aside smaller amounts to ensure payment of future claims, and can more actively invest this money, before any claims must be paid.

With this background in mind, let's move on to the core argument of this paper.

Two Reinsurance Paradigms

The reinsurance market is highly influenced by two powerful paradigms: diversification and risk aversion. Of course, diversification and risk aversion are related (diversification being a means of controlling risk), but we believe that traditional reinsurers seek unnecessarily high levels of diversification and are overly risk averse when viewed from the standpoint of portfolio efficiency.

Before we explain what accounts for this, have a look at the indicative pricing shown in Table 1 for different levels of risk and how they differ between deals that are considered by the industry to be “non-diversifiers” (contracts exposed solely or predominantly to U.S. wind, the world's largest reinsurance market) and “diversifiers” (contracts exposed to European wind, Japanese wind or earthquake, and perils in other regions of the world). The entire table is quoted in percentage points of the limit sold by a deal. The expected loss column shows different levels of risk. The price columns show the premiums paid for the coverage (called “rate on line” by industry professionals), net of brokerage fees (which typically are 5–15% of the premium). The figures in the expected profit columns are simply the price minus the expected loss. Thus, if a reinsurance deal provides \$100 million of coverage to the insurer (like Layer D in Figure 1), and its price is 9%, this means the insurer pays the reinsurer \$9 million for the coverage. If the deal has Layer D's 2.5% expected loss (or \$2.5 million), then the expected profit of the deal is \$6.5 million.

[Table 1]

Expected Loss ⁴	Non-Diversifiers (mostly U.S. wind)		Diversifiers	
	Price	Expected Profit	Price	Expected Profit
2%	7 – 12%	5 – 10%	1 – 6%	-1 – 4%
7%	15 – 22%	8 – 15%	6 – 14%	-1 – 7%
20%	32 – 42%	12 – 22%	18 – 30%	-2 – 10%

4 All figures in this table reflect what we believe to be typical pricing available in the reinsurance market as of December 2011. The expected loss figures shown represent internal estimates for select deals observed in the market. Those expected loss estimates are more conservative—often significantly more conservative—than the expected loss figures referenced by insurers and those generated by third-party risk modeling software.

Table 1 shows how the expected profit is lower for deals with a lower expected loss and how the industry charges less for deals with the same expected loss if they contribute to diversification. We argue that reinsurers sometimes undercharge for deals that are less risky or that are considered diversifiers, and that two related but not purely identical impulses, diversification and risk aversion, explain why. Let's explore those two urges in more detail.

Diversify, Diversify, Diversify

We noted previously that insurers seek to shift their concentrated risk to reinsurers in an effort to reduce their capital requirements. Reinsurers can take that risk on a more capital-efficient basis than insurers at least in part because of their ability to reinsure a variety of insurance companies and diversify their exposure to different catastrophic events.

The concept of insurance diversification was well understood by the patrons of Edward Lloyd's bustling London coffee house in the late 17th century. London's importance as a trading center in that period had intensified demand for ship and cargo insurance. Ship owners, highly exposed as they were to the risk of losing their prized vessels to weather, piracy, pilot error, and other perils, came to Lloyd's coffee house seeking to offload that risk to investors. Those investors divided the risk of insuring one ship into multiple pieces, enabling them to diversify their own portfolios by selling protection on portions of many ships. That's how the Lloyd's organization—still probably the largest market for catastrophic risk—got its start.

We'll highlight three factors that may drive the demand for diversification, sometimes beyond what we think might be rational for risk management purposes.

Rating Agencies: Diversification plays a large role in the ability of modern reinsurers to obtain a quality credit rating from one or more of the major rating agencies, such as A.M. Best Company and Standard & Poor's. Rating agencies allow reinsurers to write more business than their balance sheets would otherwise permit because those agencies don't require that the exposure to each contract be fully collateralized. This not only serves the narrow interests of reinsurers, but by effectively allowing them to leverage their capital, also broadly benefits the economy by allowing insurers and reinsurers to write more policies. For the insurance industry as a whole, collateralizing every potential loss would not be economical, let alone feasible. At the limit, if the entire world

were reinsured against loss, a duplicate world would be required to ensure payment under all scenarios.

Under rating agency guidelines, rated carriers may write business that substantially exceeds their amount of capital as long as they remain diversified enough to absorb certain losses that have reasonably low probabilities.⁵ For example, rating agencies would rate reinsurers on their ability to avoid insolvency from events that may occur once in 100 or 250 years (the so-called "probable maximum loss," or PML). As a result, rating agencies create incentives for reinsurers to diversify, which, while rational, may lead reinsurers to overvalue diversification when evaluated solely from a portfolio optimization framework.

Firms that operate fully collateralized, unrated entities are not directly subject to such requirements. However, some managers obtain leverage by using a "fronting" structure in which a traditional, rated reinsurer assumes risk on behalf of the unrated entity for a fronting fee. If the collateralized reinsurer's book is sufficiently diversified, the fronting company may allow the unrated entity, for additional fees, to post collateral in an amount less than its total portfolio of risk. This hybrid structure thus incentivizes the unrated entity to pursue diversification, too.

Public Market Pressures: A majority of reinsurance companies are publicly traded and as such the subject of continuous scrutiny by sell-side analysts. The executives of these reinsurers are expected to outperform their peers and beat analyst estimates each quarter rather than over the longer term. To achieve those objectives, they typically are heavily incentivized to avoid volatile results, increasing their desire for a more diversified portfolio than might be the case if the company were privately held. Similarly, privately held reinsurers owned by hedge fund managers may be averse to the optics of drawdowns and the attendant concerns of their investors. Although this emphasis on reducing volatility may be sound as a general principle of risk management, it can be overplayed in any market, as we believe it often is in the reinsurance space.

Segmentation in the Reinsurance Industry: Reinsurers typically divide their underwriting activities into various segments, with each business line organized by geographic region or type: U.S., international (non-U.S.), aviation, marine, and so forth. This kind of segmentation is rational

⁵ In the interest of brevity, this paper has simplified many of the complexities associated with the activities of and constraints imposed by rating agencies.

and allows reinsurers to develop and build upon a repository of expertise that, over time, offers considerable advantages.

But segmentation may also incentivize an organization to write different lines of business for reasons other than the economic attractiveness of any given deal. Each desk has an interest in maintaining its share of the company's business, possibly with less concern for the firm's overall profitability. Senior management may also have an interest in ensuring a continual flow of business to all of its desks for more general reasons, such as maintaining market share (and the firm's standing in industry league tables) or generating top-line revenue. There are alternatives. For example, our reinsurance group isn't divided into different segments, permitting us to operate efficiently with a smaller team. We also tend to write fewer, even if more customized, deals than traditional, rated competitors, allowing us additional room to operate with smaller staff, opportunistically devoting our attention only to the segments of the market that we believe have the most potential upside.

Risk Aversion

Reinsurers tend to be very risk averse. Reinsurers shy away from risk to a degree that we believe is suboptimal for them, which, again, creates attractive investment opportunities. One often hears in reinsurance circles the refrain, "I didn't lose a lot of money from X" (where X is some recent catastrophic event). While losing money is never pleasant, many in the industry seem to focus more on losses avoided than profits missed. A member of our reinsurance team with a long industry pedigree once said, "For 25 years I was taught to avoid risk; when I joined D. E. Shaw, my focus turned to evaluating whether I am being paid enough for taking the risk." Our view is that one should always assess the risk taken against the reward for taking it, and we feel the industry typically places too much emphasis on the former and not enough on the latter. It's interesting to note that the commercially available risk-modeling tools most widely used by many in the reinsurance industry do not incorporate the premium received by reinsurers as a core element of the risk analysis. We thus don't believe those tools provide a sufficient basis for fully estimating the risk-reward tradeoff of a particular deal.

When reinsurers underwrite risk, they typically focus on less risky deals like the "higher layers" (Layers C and D) in Figure 1. Those layers would be hit only if an unusually large event occurred, which is a low-probability outcome. To use a capital markets analogy, reinsurers like to write "out-of-the-

money" put options. Why would reinsurers typically write most of their business at such low levels of risk? We identify three potential drivers of this risk aversion.

Rating Agencies: In addition to incentivizing diversification, rating agencies play an important role in driving underwriters away from risk. As already noted, rating firms often focus on a reinsurer's ability to absorb a 1-in-100-year (or 1-in-250-year, or other rare frequency) event for each peril that it underwrites. In general, deals that have a lower probability of getting hit (e.g., Layer D in Figure 1) tend to have a lesser effect on such rating agency constraints than deals with a higher probability. That is, for each dollar of limit sold by a reinsurer, underwriting such lower probability risk will result in less of an increase in the cumulative 1-in-100-year modeled loss than would a deal with a higher chance of getting hit (e.g., Layer B in Figure 1). This is partly because of how reinsurance contracts interact with each other.

To demonstrate that point, consider the following example. A reinsurer may write \$100 million of coverage for one insurer in Florida and another \$100 million contract for an insurer in Louisiana. If the reinsurer were to suffer losses, in most cases it would be because it lost on either the Florida or the Louisiana contract. But there would be a smaller but still significant chance it would suffer losses on *both* contracts if, say, a hurricane swept through Florida only to make landfall again in Louisiana (as Hurricane Katrina did in 2005). Let's assume for simplicity that a third of all storms that hit either Florida or Louisiana actually hit both, and that the expected loss of each \$100 million contract is 15%, a very aggressive level of risk by industry standards. The probability that both contracts will be hit by the same event and cause the reinsurer a \$200 million loss is thus 5% (a third of 15%),⁶ much higher than the 1% level around which the reinsurer is probably optimizing its portfolio. As a result, when modeling the two deals, this reinsurer would see a very big increase in its cumulative 1-in-100-year modeled loss (close to the \$200 million of limit it wrote). By contrast, if the reinsurer were to write the same two deals but with a considerably smaller expected loss of 2% for each, the probability of a \$200 million loss from one event would be only 0.66%, and the resultant increase in its cumulative 1-in-100-year modeled loss would likely be a lot lower (probably around the \$100 million of limit it sold in each state). Thus, if the reinsurer wanted to write more business (in terms of its limit

⁶ To simplify this example, we are implicitly making certain assumptions that may not apply in all cases.

of coverage) in both states, it's incentivized to write less risky business to reduce the probability of a simultaneous loss in both states and hence to reduce the effect, if any, on its 1-in-100-year constraint.

As discussed earlier, although many fully collateralized players in the reinsurance space operate unrated entities and as such are not affected by the risk metrics employed by rating agencies, many of those players—and a growing number, it seems—enter into leverage arrangements of various sorts, which may entail constraints on their book similar to those imposed by rating agencies.

Agency Issues: Humans naturally attempt to avoid negative outcomes and are averse to financial losses. Although this tendency can confound any investment activity, we believe that the structure of the reinsurance industry promotes unusually strong risk aversion and gives rise to agency issues between investors in and managers of reinsurance portfolios. We believe that reinsurance, with its low correlation to other investment activities, can be unusually diversifying for the average investor. A rational investor, who will likely invest only a small portion of his total assets in reinsurance, should probably seek more risk in the reinsurance portion of his portfolio than his reinsurance manager might rationally desire. After all, the manager to whom that investor has entrusted his capital, whether through a reinsurance hedge fund or by investing in the stock of a reinsurance company, has quite concentrated exposure to the sector.

Employees of traditional reinsurance companies and some fully collateralized reinsurance players have a very concentrated exposure to reinsurance risk. Those personnel depend on the continued solvency of their company for their salary and year-end bonus and may have invested a significant portion of their wealth in the firm. That structural risk exposure may place significant downward pressure on risk-taking. Moreover, especially in traditional reinsurance companies, compensation schemes may incentivize employees to take reduced risk because they are compensated less for generating upside that may come from taking properly priced risk than they are for avoiding losses altogether.

Although agency problems in a variety of investment contexts typically result in managers taking *excessive* risk at the potential expense of investors, too often, we believe, reinsurers take *too little* risk and thereby deliver suboptimal returns for investors.

Capital Markets Pressure: Finally, trading in public markets may intensify risk aversion. As previously noted, publicly traded reinsurers face market scrutiny regarding their short-term results, which may lead them to shy away from risk. Although a privately held company may not have the same advantages in terms of accessing permanent capital, it may have more latitude to take on levels of risk that more closely align it with the long-term interests of its investors.

When Are Diversification and Risk Avoidance Overpriced?

We have seen how many operators structure their reinsurance businesses to take advantage of leverage, access to capital markets, and the scale that comes with segmenting their operations. In isolation, each of those attributes would seemingly enhance the efficient use of capital. But when combined with the compensation structures and certain agency issues that prevail in much of the industry, those attributes have turned into a hard constraint. As a result, we believe, the market for reinsurance is actually inefficient.

Given the incentives and constraints outlined in the previous section, most players have no choice but to diversify their books and avoid risk. The mutually reinforcing goals of diversification and risk avoidance mean that many of those active in the reinsurance market must compete heavily for what they perceive as “diversifiers”—contracts, often in smaller markets, that are critical for meeting rating agency or fronting arrangement diversification requirements—and lower-risk deals. With an entire industry chasing such deals, their pricing tends to fall to levels that are less and less attractive. At the same time, to compensate for the increasingly unattractive pricing on diversifiers, and sometimes low-risk deals, other segments of the reinsurance space that have higher risk or generally don't contribute to diversification—most noticeably, the U.S. wind segment of the market—effectively make up for that reduced profitability. One can see that dynamic as a way in which the non-diversifying geographic zones and certain higher-risk deals are subsidized by diversifiers and lower-risk deals. In this section, we discuss general considerations in pricing diversification and risk avoidance. In the following section, we briefly discuss a more flexible approach that may avoid those pitfalls.

As shown in Table 1 on page 4 above, diversified risks and low-probability risks offer much lower expected

profit to the risk taker. Although adjusting pricing for the value of diversification and reduced risk is rational, when should diversification be considered “overvalued” and risk avoidance “inefficient?” A full quantitative analysis, including the specification and justification of various subjective assumptions, is beyond the scope of this paper. Instead, we’ll lay out a few considerations that we think should be applied when evaluating the price of diversification and the degree of investor risk aversion, and that we believe are not always fully reflected in reinsurance pricing. We should note at the outset that many of these considerations are not specific to the reinsurance industry but apply to the pricing of risk generally.

Selling Risk at an Expected Loss

To begin with a stark example, if the price received by the reinsurer is lower than the expected loss, that’s clearly a bad deal. On a probabilistic basis, any contract with those features is projected to lose money in the long run. It would have been unnecessary to make this obvious point if we didn’t sometimes see deals with that pricing, as Table 1 suggests. Why does that happen? First, it may be that the reinsurer selling the protection has a different view of the risk and may think it’s lower than other market participants, including ourselves, estimate it to be. Second, while such a deal is projected to lose money in the long run, the reinsurer writing that business may be incentivized to accept that pricing given the relatively low probability that the deal will turn out to be a money-loser in the near term. Although a contract that pays 6% with an expected loss of 7%—and therefore has an expected “profit” that is in fact an expected loss of 1%—is a losing deal on a strictly probabilistic basis, there’s still close to a 93% chance that the deal won’t result in a payout this year, in which case the underwriter earns 6% and may end up being considered a smart investor.

Factoring in Expenses

But even if a deal has a positive expected profit, as most deals do, assessing its expected profitability also requires that we factor in the costs incurred by investors to generate the deal. For hedge funds in the reinsurance space, such costs include the fees paid to the fund manager. In the case of traditional reinsurers, operating costs are not quoted as fees but are accounted for as business expenses, which typically are 15–20% of gross premiums (in contrast to hedge fund performance fees which are typically stated on

profit, hence on a much smaller denominator).⁷ Thus a deal done by a traditional reinsurer whose expected profit isn’t at least 15–20% of the price will not yield investors any profit. As Table 1 suggests, various diversifying deals don’t meet that requirement.

Costs of Capital and Leverage

Thus far, we’ve mentioned only the bare minimum that we believe is required for a deal to have *any* positive value for investors. But investors generally expect to make higher returns on their reinsurance investment, particularly after factoring in its relative illiquidity and complexity. Of course, the particular demands of investors vary considerably by decision maker and market conditions, and the analysis grows further complicated when we consider that a reinsurance company must account for the cost of capital of not one but many investors, each with a potentially very different set of preferences and costs of capital.

In addition, for reinsurers that use leverage (through a rating or fronting arrangement), and especially when such leverage is non-recourse to investors (which is usually the case), further analysis may be required. For example, one could argue that if a rated reinsurer could write business in a region that diversifies other risks in a way that doesn’t require it to set aside any capital for the trade, then its cost of capital for the trade is essentially zero. A hypothetical example of such a trade might be a Chilean earthquake deal with a 0.5% expected loss, a 1% price, and thus a 0.5% expected profit (gross of expenses). For such a low-risk deal, some rated carriers may not be required to set aside any capital to support the trade. And because a rated entity typically does not have recourse to investors beyond the capital they invested in it, some might argue that as long as such a trade yields a profit, however small, it benefits the underlying investor. Although there may be some truth to that assertion under certain circumstances, we believe caution is warranted. In general, we are strong advocates of exercising great care when using leverage,⁸ and this precept applies to reinsurance for at least the following reasons.

First, a 0.5% chance that a Chilean quake might happen may not affect a company’s rating, but it still increases the

⁷ The reinsurance industry refers to the fraction of premiums earned that are eaten by expenses as the “expense ratio.” Most property catastrophe reinsurers have an expense ratio higher than 15–20% because they include among their expenses the brokerage fees they must pay. Here and in the rest of this paper (including in Table 1), we have excluded brokerage fees from the figures presented.

⁸ We elaborate on the benefits and hazards of financing in “Lessons from the Woodshop,” *Market Insights*, Vol. 2 No. 1 (March 2010).

company's overall risk. Writing separate contracts on 20 uncorrelated perils, each with a 1% annualized probability, may cap the maximum loss from one event at the size of the largest contract, but doing so exposes the reinsurer's total portfolio to an approximately 18% annual probability that any one of these perils will occur. As long as taking a risk of that magnitude is done intentionally, this may be a fine outcome. However, we believe that too often reinsurers and their investors overlook the implications of that risk for the entire portfolio.

Second, when employing leverage, one should consider the costs and risks associated with having that leverage revoked. A rated reinsurer, for example, may have a balance sheet that can absorb a loss from one large event, but it may still end up with a loss that is large enough to cause a rating downgrade unless it can raise more capital, which may prove challenging after such a loss. When that happens, a company may lose much of its business—as counterparties would seek to reinsure themselves with higher-rated companies—and may enter a death spiral that, while not necessarily resulting in insolvency, may force the business to wind down or be sold at an unattractive price. Either way, this will have a negative impact on shareholder equity beyond the original reinsurance loss itself.

Finally, we argue that one should maintain a healthy skepticism about deals that “model well” for rating purposes. After the 2008 global financial crisis, various commentators suggested that certain financial products were engineered to generate certain modeling results, principally from the standpoint of reducing the capital charge required to keep them on the balance sheet. Although we're not suggesting that such engineering is actively taking place in the reinsurance space, similar modeling limitations may lead market participants to take on risk that models well and so may look less risky than it really is. A purely hypothetical (and admittedly exaggerated) example demonstrating this point might be a deal that protects against a storm happening on a particular date that has a modeled expected loss of 0% simply because the event set in the model doesn't include any storm on that particular date. Tolstoy long ago recognized this when he wrote, “Happy reinsurance deals are all alike (no loss), and every unhappy one (a loss) is unhappy in its own way.”

In general, there are clear incentives and benefits for reinsurers having low-probability or out-of-the-money risks that model well. But sometimes such analysis is based on

wishful thinking and guesswork; it's harder to get one's head around the likelihood of an event estimated to occur roughly once a century and that we haven't recently experienced than it is for an event that tends to happen every three to five years and is therefore a lot more familiar. The methodological difficulties associated with those once-a-century events may expose investors to risk that is not well understood and for which they are not always well compensated.

Risk Profile

Beyond expenses, cost of capital, and leverage considerations, a key determinant of whether a deal is attractive to an investor is the investor's own risk profile, including specific concerns or preferences about exposure to particular perils or regions. In general, the more volatile a deal is, the more uncertain its risk, and the larger a deal is in an investor's portfolio, the more profit the investor should demand to fund it.

As mentioned above, we would expect that most investors will invest in reinsurance, if at all, on only a limited basis. Given that property catastrophe risk is uncorrelated to many other positions in their portfolio, we believe it's rational in most cases for them to seek to maximize the expected profit over all deals in the asset class while being less concerned about the overall risk of those deals. For these investors, participation in deals that have lower risk and a lower expected loss than other, riskier deals may be less efficient for their *total* investment portfolio.⁹

An Alternative Approach

The considerable discount offered by reinsurers for diversifiers and low-risk deals has two important implications. First, investors in many reinsurance deals may not be adequately compensated, and second, reinsurers that can tolerate a more concentrated portfolio may, from time to time, find highly profitable opportunities. Although there are surely a lot of different ways to operate profitably in the reinsurance space, here are some aspects of our firm generally, and its reinsurance business in particular, that we believe enhance our ability to prosper in that market.

- We conduct our reinsurance activity largely within the framework of our multi-strategy funds. As such, while the strategy can be very meaningful in dollar terms, it's still a relatively small part of a larger, more diversified portfolio of, in aggregate, over a dozen distinct investment activities

⁹ We are implicitly applying various assumptions that may not hold true for all investors.

apart from reinsurance. This strategy diversification enables us to write reinsurance business on opportunistic, risky, and concentrated deals, to the extent that market pricing allow us to rationally do so—in other words, as long as we're being well compensated.

- We manage an unrated reinsurance entity and are not subject to rating agency diversification requirements. Furthermore, while we have historically employed certain leverage facilities in our reinsurance strategy, we attempt to be very careful with that leverage. In keeping with that approach, we generally do not use leverage that is tied to diversification requirements and therefore do not face the diversification pressures that would normally arise for hedge fund managers using a fronting structure or other financing arrangements that require a high degree of diversification.
- Operating an unrated, collateralized entity also helps us manage reinsurance market cyclicality in general. When the pricing environment is favorable, we're able to quickly increase our reinsurance exposure; when it's not, we can quickly reduce the size of the strategy.
- Our firm is privately held and as such is not subject to earnings season pressures or analyst estimates, both of which can increase risk aversion at the expense of superior long-term risk-adjusted returns.
- We believe our firm's compensation structure helps align employee interests with those of our company and our investors. A substantial amount of most investment professionals' annual compensation is awarded as deferred compensation that is deposited in two multi-strategy funds with allocations to a range of strategies, including our reinsurance activities. This is in contrast to employees at many firms in the reinsurance industry—both traditional players and hedge fund managers—whose exposure to their employer is dominated by their reinsurance business because that's their main or even sole activity. We believe the inherent diversification of this multi-strategy approach may help incentivize the personnel supporting our reinsurance activities not to shy away from attractive, but concentrated, reinsurance risk.

Of course, structural considerations in and of themselves cannot substitute for rigorous analysis, sound judgment, and careful execution. We work very hard to construct a reinsurance portfolio with what we believe to be an optimal

expected risk-adjusted return profile, while hopefully benefiting from our flexible platform and mandate. In light of the constraints discussed in this paper, we have typically focused our reinsurance underwriting on less competitive markets offering more attractive pricing, which has historically led us to riskier but better paying contracts on non-diversifying perils. And because our reinsurance vehicle isn't rated, we can write bespoke contracts that are not beholden to rating constraints, focusing instead purely on the expected economics of such deals.

Conclusion

We have attempted to show in this paper that structural constraints and decision maker preferences are critical drivers of inefficiency in the reinsurance market. The intense demand for diversifying contracts and the general impulse to avoid risk tends to skew pricing and creates the potential for profit for those able to deploy a more concentrated and risky portfolio of reinsurance contracts. Our firm's structure and preferences may lead to a more optimal long-term reinsurance portfolio if we are successful in rigorously evaluating the tradeoffs between risk and reward.

Risk Associated with D. E. Shaw Group Investment Products

Any investment in a product deploying the strategy outlined in this document should be regarded as highly speculative, is appropriate only for sophisticated investors, and involves substantial risk that should be carefully considered before deciding whether to invest. Certain categories of risk factors that may be considered applicable to an investment in a D. E. Shaw group product include: risks associated with investing generally (e.g., no assurance of investment return, competition, *force majeure* events, counterparty risk); risks associated with certain investment strategies and activities (e.g., limited diversification, concentration, correlation, complexity of quantitative strategies, reliance on third-party service and information providers); risks associated with the structure of an investment product (e.g., ongoing offering of a product, lack of management control, limited liquidity); risks associated with the D. E. Shaw group (e.g., limited resources, reliance on key personnel, reliance on technology); risks associated with reporting, valuation, accounting, and taxation (e.g., limited availability of information on investments); legal and regulatory risks; and potential conflicts of interest and related party transactions (e.g., shared strategies, tools, and positions; conflicting positions, conflicting incentives, other business activities). For a discussion of certain risk factors applicable to D. E. Shaw group investment products, please review the risk factors outlined in the applicable Feeder's offering memorandum. It should be noted that there may be other risk factors applicable to an investment in a D. E. Shaw group product that are not identified above or in an offering memorandum but that might still result in substantial or complete losses to investors. Prospective investors should consult their own legal, investment, tax, and other advisers as to whether an investment with the D. E. Shaw group is appropriate for them.

Certain Risks Pertaining to Reinsurance Investments

Any product deploying the strategy described in this document is expected to make significant investments in assets, such as reinsurance contracts, catastrophe bonds, and other reinsurance-related investments, that derive their value from the occurrence or non-occurrence of catastrophic or other events that are traditionally the subject of insurance. The success of the investment strategy described herein is largely dependent on the ability of advisers to the product to forecast the probability and risk of various perils and to price investments appropriately. However, the probabilities of the occurrence and risk of catastrophic events, whether natural or man-made, are difficult to forecast accurately, and any such forecasts will require subjective judgments. Moreover, even accurate forecasts do not prevent against the risk of an event subject to insurance. Should such an event occur, such investments are subject to the risk of total loss or significant reduction of principal and/or income and could expose the product to liability that substantially exceeds any premium or other consideration received. In addition, supply of reinsurance may fluctuate in response to various factors, including the return on reinsurance-related investments, the frequency and severity of losses, and prevailing general economic and market conditions. Increases in the supply of reinsurance could adversely affect the reinsurance industry generally, resulting in lower premium rates, increased difficulty and cost to identify potential cedents, and less favorable policy terms and conditions, leading to losses by a product deploying the strategy described herein. Climate change could create and/or increase physical and financial risks, such as an increase in sea levels, changes in weather conditions, and an increase in extreme weather events, and could make it more difficult to predict the weather generally and related catastrophic events, which could result in financial losses to insurers and reinsurers. Finally, evolving industry practices and changing legal, judicial, social, environmental, and other conditions could have unexpected and unintended impacts on insurance claims and coverage. Such impacts may adversely affect a product deploying the strategy described herein, including by extending coverage beyond the product's underwriting intent or by increasing the number and/or size of claims.

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